

CLAIMS

- 1           1.       A composition for chemical-mechanical polishing, comprising:  
2               at least one oxidizing agent; and  
3               at least one abrasive particle having a surface at least partially coated by a  
4 catalyst, the catalyst comprising a metal other than a metal of Group 4(b), Group 5(b) or  
5 Group 6(b).
- 1           2.       The composition of claim 1, wherein the oxidizing agent comprises a per  
2 compound.
- 1           3.       The composition of claim 1, wherein the oxidizing agent comprises ozone.
- 1           4.       The composition of claim 1, wherein the oxidizing agent comprises an  
2 agent selected from a group consisting of a metal salt, a metal complex, and any  
3 combination thereof.
- 1           5.       The composition of claim 1, wherein the oxidizing agent is selected from a  
2 group consisting of hydroxylamine, a salt of hydroxylamine, and any combination  
3 thereof.
- 1           6.       The composition of claim 1, wherein the oxidizing agent is in an amount  
2 of from about 0.01 to about 30 weight percent relative to the composition.
- 1           7.       The composition of claim 1, wherein the oxidizing agent is in an amount  
2 of from about 0.01 to about 10 weight percent relative to the composition.
- 1           8.       The composition of claim 1, wherein the oxidizing agent is in an amount  
2 of from about 0.01 to about 6 weight percent relative to the composition.

1           9.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a metal oxide.

1           10.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a material selected from a group consisting of alumina, ceria, germania, silica,  
3       spinel, titania, an oxide of tungsten, zirconia, and any combination thereof.

1           11.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a metal oxide produced by a process selected from a group consisting of a sol-  
3       gel process, a hydrothermal process, a plasma process, a fuming process, a precipitation  
4       process, and any combination thereof.

1           12.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a resinous particle.

1           13.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a material selected from a group consisting of a polyacrylic acid, a  
3       polymethylacrylic acid, a polymelamine, a particle of an ion exchange resin, and any  
4       combination thereof.

1           14.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a plastic particle.

1           15.       The composition of claim 1, wherein the at least one abrasive particle  
2       comprises a material selected from a group consisting of a polyacrylic acid, a  
3       polymethylacrylic acid, a polyvinyl alcohol, and any combination thereof.

1           16.       The composition of claim 1, wherein an effective diameter of the at least  
2       one abrasive particle is from about 30 to about 170 nanometers.

1           17.     The composition of claim 1, wherein the at least one abrasive particle and  
2     the catalyst on the surface thereof together are in an amount of from about 0.01 to about  
3     50 weight percent relative to the composition.

1           18.     The composition of claim 1, wherein the at least one abrasive particle and  
2     the catalyst on the surface thereof together are in an amount of from about 0.01 to about  
3     20 weight percent relative to the composition.

1           19.     The composition of claim 1, wherein the at least one abrasive particle and  
2     the catalyst on the surface thereof together are in an amount of from about 0.01 to about  
3     10 weight percent relative to the composition.

1           20.     The composition of claim 1, wherein the catalyst comprises a metal  
2     selected from a group consisting of metals in Group 1(b) and Group 8.

1           21.     The composition of claim 1, where the catalyst comprises a metal having a  
2     standard oxidation potential of from about -0.52 to about -0.25 eV.

1           22.     The composition of claim 1, where the catalyst comprises a metal having a  
2     standard oxidation potential of from about -0.5 to about -0.4 eV.

1           23.     The composition of claim 1, wherein the catalyst comprises a metal  
2     selected from a group consisting of cobalt, copper, iron, and any combination thereof.

1           24.     The composition of claim 1, wherein the catalyst comprises a material  
2     selected from a group consisting of an oxide of the metal, an acetate of the metal, a  
3     source of ionic metal, and any combination thereof.

1           25.    The composition of claim 1, wherein the metal is substantially insoluble in  
2   the composition.

1           26.    The composition of claim 1, wherein the catalyst coats from about 5 to  
2   about 100 percent of the surface of the at least one abrasive particle.

1           27.    The composition of claim 1, wherein the catalyst coats from about 5 to  
2   about 80 percent of the surface of the at least one abrasive particle.

1           28.    The composition of claim 1, wherein the catalyst coats from about 25 to  
2   about 50 percent of the surface of the at least one abrasive particle.

1           29.    The composition of claim 1, further comprising at least one other abrasive  
2   that is free of a catalyst coating.

1           30.    The composition of claim 1, where in the other abrasive is in an amount of  
2   from about 0.01 to about 30 weight percent relative to the composition.

1           31.    The composition of claim 1, where in the other abrasive is in an amount of  
2   from about 0.01 to about 20 weight percent relative to the composition.

1           32.    The composition of claim 1, where in the other abrasive is in an amount of  
2   from about 0.01 to about 10 weight percent relative to the composition.

1           33.    The composition of claim 1, further comprising an additive selected from a  
2   group consisting of a polish-enhancement agent, a stabilization agent, a surfactant, a  
3   dispersion agent, a pH-adjusting agent, and any combination thereof.

1           34.    The composition of claim 33, wherein the additive is present in an amount  
2   of from about 0.001 to about 2 weight percent relative to the composition.

1           35.    The composition of claim 1, wherein a pH level of the composition is from  
2   about 2 to about 11.

1           36.    The composition of claim 1, wherein a pH level of the composition is from  
2   about 2 to about 8.

1           37.    The composition of claim 1, wherein the oxidizing agent is present in a  
2   prepared composition that lacks a catalyst-coated abrasive and comprises an oxidizing  
3   agent.

1           38.    The composition of claim 1, the composition sufficient for chemical-  
2   mechanical polishing of a substrate surface having a feature thereon comprising a first  
3   material selected from a group consisting of aluminum, copper, titanium, tungsten, any  
4   alloy thereof, and any combination thereof.

1           39.    The composition of claim 38, the composition sufficient for chemical-  
2   mechanical polishing of the substrate surface comprising a second material adjacent the  
3   feature, the second material selected from a group consisting of tantalum, tantalum  
4   nitride, titanium, titanium nitride, titanium tungsten, tungsten, and any combination  
5   thereof.

1           40.    A method of polishing a substrate surface having at least one feature  
2   thereon comprising a metal, comprising:  
3       providing the composition of any one of claims 1-5, 9, 12-14, and 20-25; and  
4       chemical-mechanical polishing the feature with the composition.

1           41.     The method of claim 40, wherein said providing comprises combining the  
2 at least one abrasive particle, the surface of which is at least partially coated with the  
3 catalyst, with a prepared composition, the prepared composition lacking a catalyst-coated  
4 abrasive and comprising an oxidizing agent.

1           42.     The method of claim 40, wherein the metal is selected from a group  
2 consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any  
3 combination thereof.

1           43.     The method of claim 40, wherein the feature is adjacent a material selected  
2 from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride, titanium  
3 tungsten, tungsten, and any combination thereof.

1           44.     The method of claim 40, wherein the chemical-mechanical polishing  
2 comprises applying a pressure of from about 1 to about 6 pounds per square inch to the  
3 feature.

1           45.     The method of claim 40, said method sufficient to remove the metal at a  
2 rate of from about 100 to about 15,000 Angstroms per minute.

1           46.     The method of claim 40, said method sufficient to provide the substrate  
2 surface at from about zero to about 40 percent within-wafer nonuniformity.

1           47.     The method of claim 40, said method sufficient to provide the substrate  
2 surface at from about zero to about 12 percent within-wafer nonuniformity.

1           48.     The method of claim 40, said method sufficient to provide the substrate  
2 surface wherein any microscratch thereon produced during the chemical-mechanical  
3 polishing is less than about 20 Angstroms.

1           49.     A substrate having a surface comprising at least one feature thereon  
2 comprising a metal, said substrate produced by the method of claim 40.

1           50.     The substrate of claim 49, wherein the metal is selected from a group  
2 consisting of aluminum, copper, titanium, tungsten, any alloy thereof, and any  
3 combination thereof.

1           51.     The substrate of claim 49, wherein the feature is adjacent a material  
2 selected from a group consisting of tantalum, tantalum nitride, titanium, titanium nitride,  
3 titanium tungsten, tungsten, and any combination thereof.

1           52.     The substrate of claim 49, the substrate surface having from about zero to  
2 about 40 percent within-wafer nonuniformity.

1           53.     The substrate of claim 49, the substrate surface having from about zero to  
2 about 12 percent within-wafer nonuniformity.

1           54.     The substrate of claim 49, wherein any microscratch on the substrate  
2 surface produced during the chemical-mechanical polishing is less than about 20  
3 Angstroms.